MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XXI. *June* 14, 1861. No. 8.

Dr. LEE, President, in the Chair.

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J. H. Dallmeyer, Esq., 19 Bloomsbury Street,

were balloted for and duly elected Fellows of the Society.

On the Secular Acceleration of the Moon's Mean Motion. By W. F. Donkin, Esq., M.A., F.R.S., F.R.A.S., Savilian Professor of Astronomy in the University of Oxford.

The controversy respecting the Moon's acceleration is one upon which no mathematician, professionally connected with Astronomy, could be content to accept without examination the conclusions of others. For my own satisfaction, therefore, I undertook the following investigation of the coefficient of m^4, the calculation of which involves the whole mathematical question. For this purpose I have used the method of the variation of elements, which has already been applied by M. Delaunay; but as I have not had an opportunity of seeing what he has published on the subject, my own result is quite independent. It will be seen that the value which I obtain for the term in question agrees with that given by Professor Adams, the correctness of which no longer admits, in my mind, of any question. The process is quite elementary, and every step may be verified by any one who is moderately familiar

with the principles of Physical Astronomy. The latest publication which has reached me on the subject is that of M. de Pontécoulant, in the *Monthly Notices*, vol. xx. No. 9. The error of his calculation admits of being very briefly stated: it consists simply in the transposition of the symbols δ and d' in the first term of the formula (*c*), p. 355. If the original derivation of the formula be referred to, it will be seen at once that $\int \delta\, d'\mathrm{R}$ ought to be written instead of $\int d'\, \delta\mathrm{R}$. The effect of the transposition is, that all the non-periodic terms which exist in $\delta\, d'\mathrm{R}$ are lost. These terms are produced by integration, *when e′ is treated as variable*, in forming the expression $\delta\, d'\mathrm{R}$; but no such terms can arise in $d'\, \delta\mathrm{R}$. If e' were treated as constant, the transposition of symbols would be immaterial. Thus we are brought back to the question whether e' is to be treated as constant or variable in integration. If any one persist in maintaining the former proposition, I do not think his opinion is likely to be affected by argument.

Neglecting the inclination, I denote by a, ε, e, ϖ, the variable elements of the Moon's orbit, viz. the major semiaxis, the mean longitude of the epoch, the excentricity, and longitude of perigee, of the instantaneous ellipse. The sum of the masses of the Earth and Moon being put $= 1$, n is defined by the equation $n^2 a^3 = 1$. The Moon's mean longitude is denoted by l, and defined by the equation $l = \int n\, dt + \varepsilon$; so that, in forming the term $\frac{d\mathrm{R}}{da}$ in the value of $\frac{d\varepsilon}{dt}$, the differentiation is not to affect n as contained in l. Accented letters refer to the Sun, and the elements of the Sun's orbit are supposed to be given functions of t.

It is convenient to choose n, ε, e, ϖ, as the four variables to be determined as functions of t. Then, since $\frac{dn}{dt} = -\frac{3}{2} a^{-\frac{5}{2}} \frac{da}{dt}$, we have, by the usual formulæ, neglecting e^2,

$$\frac{dn}{dt} = -\frac{3}{a^2}\frac{d\mathrm{R}}{d\varepsilon}, \quad \frac{d\varepsilon}{dt} = -2na^2\frac{d\mathrm{R}}{da} + \frac{1}{2}nae\frac{d\mathrm{R}}{de},$$

$$e\frac{de}{dt} = -na\frac{d\mathrm{R}}{d\varpi}, \quad e\frac{d\varpi}{dt} = na\frac{d\mathrm{R}}{de}.$$

If the disturbing function R be multiplied by a constant k, the value of which is finally to be put $= 1$, we may suppose the integral equations of this system to be developed in series proceeding by powers of k, of the form

$$n = \mathrm{n} + k\delta_1 n + k^2\delta_2 n + \ldots, \qquad \varepsilon = \varepsilon_0 + k\delta_1\varepsilon + \ldots,$$

$$e = \mathrm{e} + k\delta_1 e + \ldots, \qquad \varpi = \varpi_0 + k\delta_1\varpi + \ldots,$$

in which n, ε_0, e, ϖ_0, are four arbitrary constants independent of k, and $\delta_1 n$, $\delta_2 n$, &c. are the parts of the variable elements due to the first, second, &c. powers of the disturbing force, and containing in general both periodic and non-periodic terms.

The Sun's mean motion being n', which may be considered as constant, I put $\frac{n'}{n} = m$, so that m is a constant.

The *observed mean motion* of the Moon is the non-periodic part of $\frac{dl}{dt}$, that is, of $n + \frac{d\varepsilon}{dt}$: denoting this by N, I put $\frac{n'}{N} = m$, so that m is variable because N is variable.

I denote by l the value of l corresponding to $k = 0$, that is $l = nt + \varepsilon_0$; so that, putting $k = 1$, we may write

$$l = l + \delta_1 l + \delta_2 l + \ldots, \qquad N = n + \delta_1 . \frac{dl}{dt} + \delta_2 . \frac{dl}{dt} + \ldots$$

in the last of which formulæ we are only to take the non-periodic parts of $\delta_1 . \frac{dl}{dt}$, &c.

It must be observed that the periodic terms which are integrated in the first approximation have, in general, arguments of the form $(i + m i') n t + \ldots$. But for the purpose of finding the non-periodic part of $n + \frac{d\varepsilon}{dt}$ as far as $m^4 e'^2$, the denominator introduced by integration may be always taken to be $i n$, since the retention of the complete denominator would only introduce m^5, &c.

Putting $l - l' = \xi$, $l - \varpi = \varphi$, $l' - \varpi' = \varphi'$, we have, so far as is required for the present purpose,

$$R = n'^2 a^2 \left\{ \frac{1}{4} + \frac{3}{8} e'^2 + \left(\frac{3}{4} - \frac{15}{8} e'^2 \right) \cos 2\xi \right.$$

$$- \left(\frac{1}{2} + \frac{3}{4} e'^2 \right) e \cos \varphi + \left(\frac{3}{4} - \frac{15}{8} e'^2 \right) e \cos (2\xi + \varphi) - \left(\frac{9}{4} - \frac{45}{8} e'^2 \right) e \cos (2\xi - \varphi)$$

$$- \frac{3}{8} e' \cos (2\xi + \varphi') + \frac{21}{8} e' \cos (2\xi - \varphi')$$

$$- \frac{3}{4} e e' \cos (\varphi - \varphi') + \frac{21}{8} e e' \cos (2\xi + \varphi - \varphi') + \frac{9}{8} e e' \cos (2\xi - \varphi + \varphi')$$

$$\left. - \frac{3}{4} e e' \cos (\varphi + \varphi') - \frac{3}{8} e e' \cos (2\xi + \varphi + \varphi') - \frac{63}{8} e e' \cos (2\xi - \varphi - \varphi') \right\}.$$

This expression comprises all terms of the first and second

orders in the excentricities, not multiplied by powers of $\frac{a}{a'}$, except one term involving $e' \cos \varphi'$, and terms multiplied by e^2 or e'^2, which would be useless. The only terms required of the third order are those multiplied by $e\,e'^2$ with the same arguments as those of the first order multiplied by e. There can be no question about the correctness of the coefficients, which agree with those of M. de Pontécoulant (*Théorie Analytique*, t. iv. p. 58). I have, however, verified them all independently.

Putting $k = 0$, we should have $n = \mathrm{n}$, $\varepsilon = \varepsilon_0$, $e = \mathrm{e}$, $\varpi = \varpi_0$; and these values are to be substituted in the differential equations for the next approximation. Taking, first, the non-periodic part of R, we thus obtain (putting $k = 1$),

$$\frac{dn}{dt} = 0, \quad \frac{de}{dt} = 0, \quad \frac{d\varpi}{dt} = 0, \quad \frac{d\varepsilon}{dt} = \frac{n'^2}{\mathrm{n}}\left(-1 - \frac{3}{2}e'^2\right);$$

whence

$$n = \mathrm{n}, \quad e = \mathrm{e}, \quad \varpi = \varpi_0, \quad \frac{d\varepsilon}{dt} = -\mathrm{m}^2\mathrm{n}\left(1 + \frac{3}{2}e'^2\right),$$

and

$$\mathrm{N} = \mathrm{n}\left(1 - \mathrm{m}^2 - \frac{3}{2}\,\mathrm{m}^2 e'^2\right) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (\mathrm{A}).$$

These are the only non-periodic terms depending on the first power of the disturbing force, and not involving e^2, &c., or e'^4, &c.

In the periodic part of R, it is convenient to take separately those terms which involve e, and those which do not. The latter are of the form

$$n'^2 a^2 p \cos (2l + \psi),$$

where p contains e' or e'^2, and ψ is independent of quantities referring to the Moon. The differential equations obtained from this term give

$$\left.\begin{aligned} \frac{d\varepsilon}{dt} &= -4\frac{n'^2}{n}\,p \cos (2l + \psi), \\ \frac{dn}{dt} &= \quad 6\,n'^2\,p \sin (2l + \psi), \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad (1).$$

and, introducing in their right-hand members the values corresponding to $k = 0$, we have for a first approximation,

$$\frac{d\varepsilon}{dt} = -4\,\mathrm{m}^2\mathrm{n}\,p \cos (2\mathrm{l} + \psi), \quad \frac{dn}{dt} = 6\,\mathrm{m}^2\mathrm{n}^2 p \sin (2\mathrm{l} + \psi).$$

In integrating these we are to consider p as variable, because it contains e'; but since $\frac{de'}{dt}$ and $\frac{d.e'^2}{dt}$ may be regarded as constant, we may treat $\frac{dp}{dt}$ as constant also. Hence, integrating by parts, we obtain $\varepsilon = \varepsilon_0 + \delta_1 \varepsilon$, $n = \mathrm{n} + \delta_1 n$, where

$$\delta_1 \varepsilon = -2\,\mathrm{m}^2 p \sin(2l + \psi) - \frac{\mathrm{m}^2}{\mathrm{n}} \frac{dp}{dt} \cos(2l + \psi),$$

$$\delta_1 n = -3\,\mathrm{m}^2 \mathrm{n}\, p \cos(2l + \psi) + \frac{3}{2}\,\mathrm{m}^2 \frac{dp}{dt} \sin(2l + \psi);$$

From the latter expression we have, integrating again by parts,*

$$\int \delta_1 n \,.\, dt = -\frac{3}{2}\,\mathrm{m}^2 p \sin(2l + \psi) - \frac{3}{2}\,\frac{\mathrm{m}^2}{\mathrm{n}}\,\frac{dp}{dt} \cos(2l + \psi);$$

whence, observing that $l = l + \delta_1 \varepsilon + \int \delta_1 n \,.\, dt$, we have

$$\delta_1 l = -\frac{7}{2}\,\mathrm{m}^2 p \sin(2l + \psi) - \frac{5}{2}\,\frac{\mathrm{m}^2}{\mathrm{n}}\,\frac{dp}{dt} \cos(2l + \psi).$$

For the next approximation we are to resume the equations (1), putting in their right-hand members $\mathrm{n} + \delta_1 n$, $l + \delta_1 l$, instead of n, l; hence, observing that $\frac{1}{n} = \frac{1}{\mathrm{n}} - \frac{1}{\mathrm{n}^2}\,\delta_1 n$, &c., and, taking only the non-periodic parts of the result, we obtain

$$\frac{d\varepsilon}{dt} = -20\,\mathrm{m}^4 \mathrm{n} p^2, \qquad \frac{dn}{dt} = -15\,\mathrm{m}^4 \mathrm{n} p \frac{dp}{dt};$$

the latter equation gives, by integration, $\delta_2 n = -\frac{15}{2}\,\mathrm{m}^4 \mathrm{n}\, p^2$; hence, so far as this term in R is concerned, the non-periodic part of $\frac{dl}{dt}$, or of $n + \frac{d\varepsilon}{dt}$, is $-\frac{55}{2}\,\mathrm{m}^4 \mathrm{n}\, p^2$.

If p be of the form $\alpha + \beta e'^2$, this gives (neglecting e'^4),

$$\delta_2 \cdot \frac{dl}{dt} = -55\,\mathrm{m}^4 \mathrm{n}\, \alpha \beta e'^2;$$

* The constant, which in strictness ought to be added, would not affect the result.

but if p be of the form $\alpha e'$, then

$$\delta_2 \cdot \frac{dl}{dt} = -\frac{55}{2} \mathrm{m}^4 \mathrm{n}\, \alpha^2 e'^2.$$

There is one term in R of the former kind, in which $\alpha = \frac{3}{4}$, $\beta = -\frac{15}{8}$; and two terms of the latter kind, in which $\alpha = -\frac{3}{8}$, and $\alpha = \frac{21}{8}$ respectively; hence the part of N arising from these terms is

$$55\left(\frac{45}{32} - \frac{9}{128} - \frac{441}{128}\right) \mathrm{m}^4 \mathrm{n}\, e'^2 = -\frac{7425}{64} \mathrm{m}^4 \mathrm{n}\, e'^2 \quad . \quad . \quad \text{(B)}$$

The remaining terms of R are of the form

$$n'^2 a^2 p\, e \cos (i\, l + j\, \varpi + \psi),$$

where p contains e'. The differential equations now become

$$\frac{dn}{dt} = 3\, i\, n'^2 p\, e \sin (i\, l + j\, \varpi + \psi),$$

$$\frac{d\varepsilon}{dt} = -\frac{7}{2} \frac{n'^2}{n} p\, e \cos (i\, l + j\, \varpi + \psi),$$

$$\frac{de}{dt} = j \frac{n'^2}{n} p \sin (i\, l + j\, \varpi + \psi),$$

$$\frac{d\varpi}{dt} = \frac{n'^2 p}{n\, e} \cos (i\, l + j\, \varpi + \psi).$$

Proceeding in the same way as before, we obtain from the last two equations

$$\delta_{,}\varepsilon = -\frac{j}{i} \mathrm{m}^2 p \cos (i\,\mathrm{l} + j\, \varpi_0 + \psi) + \frac{j}{i^2} \frac{\mathrm{m}^2}{\mathrm{n}} \frac{dp}{dt} \sin (i\,\mathrm{l} + j\, \varpi_0 + \psi)$$

$$\delta \varpi = \frac{1}{i} \frac{\mathrm{m}^2 p}{\mathrm{e}} \sin (i\,\mathrm{l} + j\, \varpi_0 + \psi) + \frac{1}{i^2} \frac{\mathrm{m}^2}{\mathrm{n\,e}} \frac{dp}{dt} \cos (i\,\mathrm{l} + j\, \varpi_0 + \psi);$$

and putting $\mathrm{e} + \delta_{,} e$, $\varpi_0 + \delta_{,}\varpi$, for e, ϖ, in the first two, and observing that $\delta_{,} l$ and $\delta_{,} n$ would only give terms multiplied by e^2, so that we may put 1 for l and n for n, we find for the non-periodic parts

$$\frac{dn}{dt} = 3 \frac{j}{i} \mathrm{m}^4 \mathrm{n}\, p \frac{dp}{dt}, \qquad \frac{d\varepsilon}{dt} = \frac{7}{2} \frac{j}{i} \mathrm{m}^4 \mathrm{n}\, p^2;$$

hence $\delta_2 n = \frac{3}{2}\frac{j}{i}\, m^4 n p^2$, and the non-periodic part of $\frac{dl}{dt}$ is $5\frac{j}{i}\, m^4 n p^2$. Hence, if p be of the form $\alpha + \beta e'^2$, we have

$$\delta_2 \cdot \frac{dl}{dt} = 10\frac{j}{i}\, m^4 n \alpha \beta e'^2;$$

but, if p be of the form $\alpha e'$, then

$$\delta_2 \cdot \frac{dl}{dt} = 5\frac{j}{i}\, m^4 n \alpha^2 e'^2.$$

There are three terms in R of the former kind, in which

$$\alpha = -\frac{1}{2}, \quad \beta = -\frac{3}{4}, \quad i = 1, \quad j = -1,$$
$$\alpha = \frac{3}{4}, \quad \beta = -\frac{15}{8}, \quad i = 3, \quad j = -1,$$
$$\alpha = -\frac{9}{4}, \quad \beta = \frac{45}{8}, \quad i = 1, \quad j = 1;$$

and the part of N, arising from these terms, is therefore,

$$10\left(-\frac{3}{8} + \frac{15}{32} - \frac{405}{32}\right) m^4 n e'^2 = -\frac{8040}{64}\, m^4 n e'^2 \quad . \quad . \quad . \quad (C)$$

There are six terms of the latter kind, in which

$$\alpha = -\frac{3}{4}, \quad i = 1, \quad j = -1; \quad \alpha = \frac{21}{8}, \quad i = 3, \quad j = -1;$$
$$\alpha = \frac{9}{8}, \quad i = 1, \quad j = 1; \quad \alpha = -\frac{3}{4}, \quad i = 1, \quad j = -1;$$
$$\alpha = -\frac{3}{8}, \quad i = 3, \quad j = -1; \quad \alpha = -\frac{63}{8}, \quad i = 1, \quad j = 1;$$

and the part of N, arising from these, is therefore

$$5\left(-\frac{9}{16} - \frac{147}{64} + \frac{81}{64} - \frac{9}{16} - \frac{3}{64} + \frac{3969}{64}\right) m^4 n e'^2$$
$$= \frac{19140}{64}\, m^4 n e'^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (D)$$

Adding the four terms (A), (B), (C), (D), we have finally

$$N = n\left(1 - m^2 - \frac{3}{2} m^2 e'^2 + \frac{3675}{64} m^4 e'^2\right);$$

but this expression has still to be transformed into one, involving m $\left(\text{or } \frac{n'}{N}\right)$ instead of m $\left(\text{or } \frac{n'}{n}\right)$.

Let N_0, e'_0, be the values of N, e', when $t = t_0$, then (since m is independent of e'),

$$N - N_0 = n \left(-\frac{3}{2} m^2 + \frac{3675}{64} m^4 \right) (e'^2 - e'^2_0);$$

also

$$\frac{1}{N} = \frac{1}{n} (1 + m^2 + \ldots);$$

hence, as far as the present approximation,

$$\frac{N - N_0}{N} = \left(-\frac{3}{2} m^2 + \frac{3579}{64} m^4 \right) (e'^2 - e'^2_0);$$

also, since $\frac{n'}{N} = m$, we have

$$m = m (1 + m^2 + \ldots),$$

and

$$m = m (1 - m^2 + \ldots);$$

whence

$$-\frac{3}{2} m^2 = -\frac{3}{2} m^2 + 3 m^4 + \ldots, \quad \text{and} \quad m^4 = m^4 + \ldots;$$

introducing these values, we obtain

$$N - N_0 = N \left(-\frac{3}{2} m^2 + \frac{3771}{64} m^4 \right) (e'^2 - e'^2_0),$$

which agrees with the conclusion of Professor Adams.

It should be observed that the notation here used is not the same as that of M. de Pontécoulant, who uses n to denote what I have represented by N, namely, the mean motion of the Moon given by observation.

[With reference to M. de Pontécoulant's calculations, it may be remarked, in addition to what was said at the beginning of this paper, that the second term in his formula (*c*) is not in its original form, but is obtained by writing $\frac{1}{2} \left(\int d' R \right)^2$ instead of $\int \left(d' R \int d' R \right)$. The latter form would give *no non-periodic term if e' were to be treated as constant;* and the non-periodic terms given by the transformation would be, on that supposition, nothing better than an arbitrary function of e', introduced as a constant in the integration. The transformation is, in fact, legitimate; but it is only so *because* e' is variable; and the non-periodic terms which it produces are precisely what would be obtained by applying the process of integration by parts in developing the form $d' R \int d' R$.]

Madeira, 27th May, 1861.

A communication has been received from M. de Pontécoulant, containing observations on M. Hansen's letter of the 2d Feb. 1861, to the Astronomer Royal, published in the March number of the *Monthly Notices*. M. de Pontécoulant remarks that in the lunar theory an *empirical* equation is one which is not founded on the rigorous principles of the law of gravitation, but is only introduced to make the results of calculation accordant with the observations; he is therefore surprised to see M. Hansen reckon in the class the motions of the perigee and node of the Moon's orbit, the determination of which motions is an obligatory condition of the theory. He thinks that M. Hansen has misapprehended the objection to Prof. Adams' method for the determination of the acceleration; and after remarking that it is at least presumable that there is no error or omission of terms in the calculations of Prof. Adams, confirmed as they are by the investigations of MM. Plana, Delaunay, and Lubbock, he continues as follows: "Si l'on veut donc regarder comme variable l'excentricité de l'orbite terrestre dans les équations du mouvement troublé de la Lune, ce qui parait en effet plus exact que de traiter cette excentricité comme une quantité constante, ainsi qu'on l'avait fait jusqu'à présent, et ce qui avait paru suffisant pour la comparaison des plus anciennes observations qui nous soient parvenus, il faudrait alors substituer dans les équations différentielles du mouvement troublé de la Lune à la place de e', qui répresente l'excentricité de l'orbite terrestre, sa valeur exprimée en série de *sinus* et de *cosinus* d'arcs proportionnels à la longitude vraie de la Lune si l'on se sert des formules de Laplace, et proportionnels à sa longitude moyenne si l'on fait usage des formules ordinairement employées dans la théorie des planètes, de même que l'on substitue dans ces équations les valeurs des autres co-ordonnés du Soleil developpées de la même manière avant d'opérer leur intégration. On arrivera ainsi à une exacte évaluation de *l'équation séculaire*, qui ne différera que très legèrement de celle que les géomètres ont obtenues en négligeant dans une première approximation les variations des éléments de l'orbe solaire, et qui répresenteront les plus anciennes observations dans les limites d'exactitude que comporte l'imperfection de ces observations et le long intervalle de temps qui nous en sépare. De toute autre manière on n'obtiendra que des résultats fautifs, &c."

As to the concluding part of M. Hansen's letter, M. de Pontécoulant remarks that the conditions under which M. Hansen will approve of the only method able to give a literal and analytical solution of the problem of perturbations, on a par with the perfection of the other parts of Celestial Mechanics, are conditions which it is impossible to comply with in a question so complicated and full of difficulties—and that M. Hansen's terms amount to a refusal to accept in the lunar theory any other solution than that by mechanical substitutions.

But M. de Pontécoulant asks if the convergence of the series needs to be established *à priori;* or whether it is not sufficiently proved by the results afforded by the series themselves, calculated to an extent which shows that no appreciable quantities are neglected; and by the accordance of the values of the coefficients as obtained by the series, and as laboriously deduced from many thousands of observations. And more than this, he appeals to M. Hansen himself, who has shown in the *Astronomische Nachrichten*, vol. xvii. p. 302, by reducing Damoiseau's expression for the mean longitude to the form made use of in M. Hansen's Tables, that there is a close agreement of the two expressions—while, on the other hand, M. de Pontécoulant in his Lunar Theory has shown that the coefficients obtained by the method of series accord with those of Damoiseau—and this comparison with the same mean term shows that the results obtained by M. Hansen are the reproduction in a different form of those given by the analytical method. M. de Pontécoulant states, also, that he has recently occupied himself with the converse question of the deduction of the expression for the true longitude from M. Hansen's expression of the disturbed mean anomaly, and that with two exceptions, which he reserves for further examination, he finds that the results entirely agree with those given by his own theory.

Observations of the Variable Star η Argus.

By Francis Abbott, Esq.

Passing by Sir John Herschel's observation on this very remarkable star in the year 1837, and when it attained its maximum in January 1838; also passing over the observations made by Sir Thomas Maclear at the Cape of Good Hope, and Mackay at Calcutta, in the year 1843, when *η Argus* surpassed *Canopus*, and nearly equalled *Sirius*, and preserved that brilliancy till the year 1850, when Lieut. Gillis, writing from Santiago, February 1850, describes it of a reddish yellow colour, darker than *Mars*, and nearly equal in brightness to *Canopus;* from these dates I give the following observations from my own journal:—

1856. In the early part of this year I compared *η Argus* with the united light of the two components of *α Centauri*, which it nearly equalled.

1858, Feb. 10th, a gradual diminution has taken place in the brightness of this star; it now only approximates to *β Crucis;* if any thing, rather inferior.

1858, March 6th, η *Argus* is comparable only to γ *Crucis*, the latter being of somewhat deeper colour and more sharply defined; the former dull and hazy.

1858, April 2d, to all appearance η *Argus* and γ *Crucis* are near alike both in size and colour.

1858, May 28th, η *Argus* gradually declining, γ *Crucis* being much the brighter of the two.

1858, Oct. 8th, γ *Crucis* decidedly very superior in splendour to η *Argus*.

1859, March 27th, ε *Argus* is now more sharply defined than η *Argus*, it being the nearest comparison star.

1859, July 6th, η and $\varkappa$ *Argus* are now about equal; the latter is estimated at 3d mag. = 3·35 of Herschel.

1860, Nov. 2d, δ *Crucis* is scarcely equal to η *Argus;* if anything more sharply defined; the latter looking sickly, as if dying out.

1861, March 21st, δ *Crucis* is certainly very superior to η *Argus*, being much more readily found in the fading twilight.

1861, April 8th, at this date η *Argus* has not more light than ε *Crucis*, the former having a faint milky appearance.

1861, April 13th, ε *Crucis* seen in the evening twilight 10 minutes before η *Argus*.

Private Observatory, Hobart Town.

On the Probable Identification of Anthelm's Variable of 1670 (*Nova Vulpeculæ*), *and on some other Variable Stars.* By J. R. Hind, Esq.

Early in the year 1852, I worked up the position of the star discovered by Anthelm in June, 1670, near the head of *Cygnus*, from the observations at p. 45 of Lémonnier's *Histoire Céleste*, which are probably the best that were made upon that object. The resulting place for 1850 is,

R.A. ..... $19^h\,41^m\,26^s{\cdot}8$ N.P.D. ..... $63°\,3'\,24''$.

On the 24th of April, 1852, I found close upon this point a star of 10-11 magnitude, preceding Lalande 37730 by 25 seconds in R.A, and $23''{\cdot}1$ south of it. Anthelm's star should precede about 27 seconds, with $23''{\cdot}3$ greater N.P.D., thus presenting a close agreement. I had intended to keep a watch upon this star, but, my attention being then chiefly directed to planet-hunting, I neglected to do so.

On the 24th of May in the present year, I was surprised to find the star had diminished to the 12th magnitude; and this circumstance, taken in connexion with the near accordance in

position, leads me to conclude that it is really Anthelm's *Nova Vulpeculæ*, long reputed to have become extinct. To my eye there is a hazy, ill-defined appearance about it, which is not perceptible in other stars in the same field of view. Mr. Talmage, whose sight is remarkably strong, received the same impression; and I may add that Mr. Baxendell, who has examined it with Mr. Worthington's reflector, observed that no adjustment of the focus would bring the star up to a sharp point on the night of June 1. Mr. Baxendell's estimate of its present magnitude agrees precisely with mine; and as I am quite convinced I could never have called it 10-11 in any state of the sky, its variability I believe to be established.

The Greenwich 12-year Catalogue contains a star which was observed while looking for 11 *Vulpeculæ* of Flamsteed (Anthelm's *Nova*), and which, singularly enough, was also proved to be variable, as appears from the note to No. 1773. It follows the small star alluded to above, about 48 seconds in R.A.; and, fortunately, we are able to show that it has no proper motion to account for this difference in position since 1670, the star having been observed by Bessel in Zone 432, on the 17th of August, 1828—a fact to which Mr. Baxendell was kind enough to draw my attention. The Greenwich mean place for 1836·0 is,

R.A. ..... $19^h\,41^m\,40^s{\cdot}48$ N.P.D. ..... $63°\,7'\,2''{\cdot}2$.

Bessel's observation brought up to the same epoch gives,

R.A. ..... $19^h\,41^m\,40^s{\cdot}42$ N.P.D. ..... $63°\,7'\,2''{\cdot}6$.

From this fixity of position during eight years, it may be inferred that the Greenwich variable is distinct from Anthelm's, and an addition to our list of these mysterious objects.

It appears by no means improbable that, by carefully noting the relative brightness of the stars situated near the positions of the famous variables of 1572 and 1604, we may succeed in identifying them, and thus guard against a similar surprise to that experienced by Tycho on the sudden outburst of the star in *Cassiopea* in 1572. It might thus be possible, by assiduous and patient examination of the vicinity, to secure the ascending as well as the descending light-curve, which would assuredly prove of great value in the explanation of the phenomena of irregular stars. I am, of course, assuming that, like Anthelm's star—and, I may add, the one which became suddenly visible to the naked eye in *Ophiuchus* in April 1848, —they are varying perceptibly about an *average minimum*.*

* M. Arago, in his *Astronomie Populaire*, states that this star, which I detected on 1848, April 27, has quite disappeared. It is a mistake. The star has not descended below the 12th magnitude, and is rarely so faint, though I am satisfied there is an irregular variation to an extent, between extremes, of a whole magnitude, if not more.

The place of Tycho's variable, brought up to the beginning of 1850, is

R.A. ..... $0^h\ 16^m\ 18^s{\cdot}2$ N.P.D. ..... $26^\circ\ 41'\ 55''$.

as I find by a new reduction of some of the measures of distances from stars, given in his treatise *De Stellâ Novâ Anni* 1572. His own place (R.A. and Decl.), brought up to the same date, would differ from the above $+5^s{\cdot}4$ in R.A. and $-1'{\cdot}2$ in N.P.D. On the 30th of August, 1848, I found two small stars near this position: one of 11-12 magnitude, in R.A. $0^h\ 16^m\ 20^s{\cdot}9$ and N.P.D. $26^\circ\ 38'{\cdot}8$; the other, rather fainter, in R.A. $0^h\ 16^m\ 29^s{\cdot}4$ and N.P.D. $26^\circ\ 42'{\cdot}0$. Perhaps the latter object is the more suspicious of the two, though both will require watching.

The place of Kepler's star, 1604, has been deduced from his observations by Dr. Winnecke (*Astron. Nach.* No. 1121). It is as follows, for 1850:—

R.A. ..... $17^d\ 25^m\ 49^s$ N.P.D. ..... $111^\circ\ 15'$.

Singularly enough, on examining this part of the heavens in April, 1857, Dr. Winnecke found, in this case also, two small stars near the computed position: one of 11-12th magnitude, in R.A. $17^h\ 25^m\ 47^s$ and N.P.D. $111^\circ\ 14'$; the other, a somewhat smaller star, in R.A. $17^h\ 25^m\ 45^s$ and N.P.D. $111^\circ 15'$; both stars are within the probable limits of error of Kepler's place.

On the Nomenclature of the Minor Planets.

By J. R. Hind, Esq.

In a note appended to M. Le Verrier's *Meteorological Bulletin* of the 18th of March last, attention is directed to the nomenclature of the group of planets between *Mars* and *Jupiter*, which is now so rapidly increasing in number; and it is suggested that, without continuing to give each planet a particular name, it may be a sufficient distinction to mention the number in order of discovery, attaching thereto the name of the discoverer: thus, *Astræa* would be ⑤ *Hencke; Thetis*, ⑰ *Luther; Ausonia*, ⑱ *Gasparis;* and so on. The opinions of those astronomers to whom the detection of these planets is due are invited by M. Le Verrier.

The objections to such a system of nomenclature as is here proposed appear, in my mind, so obvious and important, that I confess I read the remarks of the illustrious Director of the

Observatory of Paris with much surprise. It could not be brought into use at present, at any rate, without continual reference to a table in which the proper names now employed would be the argument, and the ordinal number and discoverer's name, together, the equation. No person, I imagine, depending upon his memory alone, could ensure the connexion of the right name with the right number: there would be continual mistakes, and we should be exposed to waste of time and trouble in deciding to what planet reference was intended to be made. Further, the true ordinal number for a planet may be in doubt for weeks or months, as the history of the discovery of these bodies has proved in several cases. Dr. Luther's last planet, *Leto*, has been repeatedly called (67) in the *Bulletins* and *Astronomische Nachrichten*, but Mr. Pogson's *Asia* is really (67); and the intelligence of his discovery of course upset the numbers which had been adopted in Europe. Instances of this kind are pretty sure to occur again.

I might trace the effects of the introduction of the proposed system further, but the two objections here advanced appear so strong and unavoidable that it may be unnecessary to dilate upon the subject. I must give a decided vote against a change which I believe, if effected, for a time would lead to confusion and useless trouble—ultimately causing a return, by general consent, to our present nomenclature.

It has been long understood amongst astronomers that names for the small planets shall be selected from those of classical antiquity. The advantage of adhering to this neutral foundation is clear enough, and I think it is to be regretted that in two or three cases an inclination to depart from it has been evinced. *Angelina* and *Maximiliana* ought, in my opinion, to be rejected, as inconsistent with the strict interpretation of the rule; or, if allowed, it should be on the understanding that no future infractions of that rule will be tolerated. This once acknowledged, a little care in the choice of names, euphonious and not liable to be confounded with others either in writing or pronunciation, would obviate the necessity of further discussion.

The view which I have taken is equally adopted by M. Goldschmidt, to whom we owe fourteen of these planets, and by Dr. Luther, who has discovered eleven. I may perhaps be allowed to add, without entering into particulars, that the Astronomer Royal and Sir John Herschel are as strongly opposed to the suggested innovation, and also our distinguished Associate, Professor Argelander.

There is one name, unobjectionable upon other grounds, which was proposed in America for Mr. Ferguson's last planet, but which had been previously appropriated by Sir John Herschel for the interior one of the two bright satellites of *Uranus:* I allude to *Titania*. Mr. Lassell has constantly used

this name in his published observations of this satellite, as may be seen from No. 813 of the *Astronomische Nachrichten*, and various numbers of the *Monthly Notices*. As it was probably selected for the planet by inadvertence, I will venture to express a hope that Mr. Ferguson will see the propriety of substituting another. *Pseudo-Daphne*, when recovered, will require a name, and (59) also, if our present system is to be continued; and I can neither directly nor indirectly favour its rejection.

Note on the Disposition of the Penumbra of a Solar Spot.

By W. R. Birt, Esq.

A spot that has recently entered on the Sun's disk has exhibited, in connexion with the phenomenon first observed and described by Dr. Wilson in 1769, an interesting disposition of the penumbra *on the side nearest the Sun's limb*, of such a character as to manifest, in the course of twenty-four hours, a distribution precisely the opposite of that described by the Doctor, in so far as the gradual appearance of the penumbra on the side furthest from the limb is concerned, that generally exhibiting, as observed by the Doctor, the smallest extent of penumbra.

1861, June $12^d\ 22^h\ 0^m$ G.M.T. A large spot with a well-defined nucleus had lately entered on the disk; the sides nearest and furthest from the limb were both destitute of penumbræ. A narrow strip of penumbra was seen between the nucleus and the limb. The margin of the nucleus furthest from the limb was sharp and well-defined.

1861, June $13^d\ 5^h\ 45^m$ G.M.T. A narrow fringe of penumbra on the side *furthest* from the limb; the luminous material of the photosphere *joining the margin* of the nucleus *nearest* the limb, the separate strip of penumbra between the nucleus having increased in size.

1861, June $13^d\ 22^h\ 0^m$. The fringe of penumbra on the side furthest from the limb increased in breadth, and wider than the penumbra nearest the limb, excepting the separate strip which has now a few small spots. The surface of the photosphere runs in between this strip and the main spot.

The spot now visible is an interesting instance of the combination of the gradual revelation of the penumbra hidden, according to Dr. Wilson, by the curvature of the solar globe with the disturbing effect of smaller spots in the neighbourhood of larger ones, of which he has given five instances. It would appear, from the sketches I made of the spot at its three

stages, that the force producing it acted from the eastward, considerably below the photosphere, in an *oblique* direction, and that the strip of penumbra, with its included small spots, resulted from this disturbing action, and not that the spots were the agents in depriving the nucleus of its penumbra, as suggested by Dr. Wilson.

On the Ring of Saturn. By W. Lassell, Esq.

The *Monthly Notice* for April contains an interesting observation of Mr. De La Rue of the shadow of the ring of *Saturn* crossing the ball. I have lately noticed the same thing, and it is remarkable that when the ring was nearly in the same position, on the 3d of August, 1849, it was so strikingly apparent that I made a drawing of the planet, of which I send an exact tracing, and entered the following remarks in my astronomical journal.

"The peculiar feature of this unequalled view was that the most minute, but extremely black shadow of the ring upon the ball was evidently *knotted or notched, conveying the idea of mountains upon the plane of the ring, intercepting portions of the thin line of shadow, and almost breaking it up into a line of dots.*"

[The underlining is in the original].

I do not find that I have published the observation before, possibly on account of its having been made in the middle of the recess of the Society, but I have slightly alluded to the appearance, *Monthly Notices*, vol. xi. page 19, in speaking of the "serrated" form of the shadow of the ring upon the ball.

As the position of *Saturn* at the respective times was almost exactly the same in respect of the proportion of the axes, and also the superior altitude of the Earth to that of the Sun above the plane of the ring, making the portion of shadow seen very nearly equal in both observations; they are strikingly confirmatory of each other, and indicate a real peculiarity of conformation of the ring.

Bradstones, Sandfield Park, near Liverpool,
22d May, 1861.

On the Ring of Saturn and on Jupiter's Satellites.

By Capt. W. S. Jacob.

I have several times lately observed something of the same appearance in *Saturn* as that referred to by Mr. De La Rue, in the April Number, p. 177, especially on the 19th May, a drawing of which I send. My first impression was, that the outline of the shadow was decidedly irregular, though to a less extent than is shown in Mr. De La Rue's drawing; but, on more careful scrutiny, and when the definition was at the best, I was inclined to think that the phenomenon might possibly be an illusion, arising from a variation in the shade or tone of the shadow, by which the darker portions appeared to project beyond the rest; the power of the instrument and the state of atmospheric definition were, however, insufficient to allow of my satisfying myself thoroughly on this point. The instrument used was the very excellent 5-foot by Tully, known as the Smythian, of which I have the loan from Dr. Lee.

Jupiter's Satellites.

There have been occurring of late several eclipses or occultations of *Jupiter's* Satellites by each other; a rather curious and interesting phenomenon, though of little practical utility.

I observed one of I. by III. on April 12th, which appeared almost exactly central.

	h	m	s	
First contact at	7	31	0	Greenwich M.T.
Central conjunction about	7	44		

Clouds prevented the observation of the last contact.

Also, on 19th May, an occultation of II. by I. not quite central, yet so nearly so, that at the time of conjunction the combined figure appeared to be round.

	h	m	s
First contact	8	56	0
Last contact	9	4	22

At $8^h\ 58^m\ 10^s$ the axis of the oval formed by the combined bodies seemed to point at *Jupiter's* upper or S. Limb, and at $9^h\ 2^m\ 40^s$ at the N. Limb.

The power employed was 180.

Hartwell, 2d June, 1861.

Note on an Appearance observed on Jupiter, by Mr. Birt, March 22, 1861. By J. Baxendell, Esq.

The appearance on *Jupiter* described by Mr. Birt at page 176 of the April number of the *Monthly Notices* was observed and sketched at Mr. Worthington's Observatory on the 17th of March last, and from observations made between that date and the 10th of April it was found that it returned to the same position on the disk of the planet in a period of $9^h\ 55^m\ 41^s.4$ mean solar time. As this agrees very nearly with the best determinations of the planet's period of rotation, we may venture to give an answer in the negative to Mr. Birt's question, "Was this an instance of a rapid propagation of cloud in the atmosphere of the planet?"

On the 10th of April a faint and narrow streak was observed lying across the bright equatoreal belt in a N.P. and S.F. direction, its lower or northern end resting upon the large northern dark belt immediately above the "ragged portion," referred to by Mr. Birt, and its upper end nearly, if not quite, touching the southern dark belt. These projections upon, and sometimes quite across, a bright belt from parts of a dark belt where unusual action is going on are not of unfrequent occurrence, but do not seem to have hitherto received the attention which they appear to merit. Probably, however, this is owing to their faintness, and the difficulty of seeing them very distinctly except with telescopes of large aperture.

Manchester, May 25, 1861.

Results of Meridional Observations of Small Planets; Occultation of a Star by the Moon; and Phenomena of Jupiter's Satellites; observed at the Royal Observatory, Greenwich, during the month of May, 1861.

(*Communicated by the Astronomer Royal.*)

Iris (7).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1861, May 4	12 29 55·4	15 21 23·15	112 40 13·69
13	11 45 39·8	15 12 29·27	111 56 7·37
14	11 40 44·5	15 11 29·70	111 50 53·23
17	11 26 0·3	15 8 32·81	111 34 54·66
18	11 21 6·3	15 7 34·54	111 29 36·16
21	11 6 27·1	15 4 42·56	111 13 16·79
24	10 51 53·8	15 1 56·60	110 56 47·09
25	10 47 4·1	15 1 2·65	110 51 23·60

Panopea (70).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
h m s	h m s	° ′ ″
1861, May 14 11 3 39·0	14 34 18·17	104 26 3·67

The observations of *Iris* in N.P.D. have been corrected both for refraction and parallax; that of *Panopea* has been corrected for refraction only.

Occultation of B. A. C. 4006 *by the Moon.*

1861, May 19. The disappearance at the Moon's dark limb was observed by Mr. Dunkin to take place at $8^h\ 53^m\ 32^s{\cdot}2$ Mean Solar Time.

Phenomena of Jupiter's Satellites.

Day of Observation. 1861.	Satellite.	Phenomenon.	Mean Solar Time.	Observer.
			h m s	
May 13	I	Eclipse, reapp.	11 13 18·9	C.
17	II	Egress, bisection (*a*)	9 47 47·3	E.
25	III	Ingress, first cont.	8 24 24·2	K.
25	III	Ingress, bisection	8 26 53·8	K.
25	III	Ingress, last cont.	8 29 53·3	K.
26	II	Eclipse, reapp.	10 1 37·5	E.

(*a*), Unsatisfactory, the images being extremely tremulous.

The initials, E., C., and K., are those of Mr. Ellis, Mr. Criswick, and Mr. Kerschner.

Occultation of Mars by the Moon, observed at the Dudley Observatory, 1861, *May* 12. By O. M. Mitchel, Jun.

(*Communicated by Professor O. M. Mitchel through the Astronomer Royal.*)

Phenomenon.	Sidereal Time of Observation.
	h m s
Disappearance	11 0 46·7
Last Contact	12 1 28·8

Very hazy; observations satisfactory, however.

Occultation observed at Highbury. By T. W. Burr, Esq.

1861, May 19th. The star B.A.C. 4006 disappeared instantaneously at the dark limb of the Moon at $12^h42^m\ 56^s{\cdot}7$, local sidereal time. The reappearance was not seen. Telescope 4 ft. 4 in. refractor; $3\frac{3}{8}$ inches aperture. Power 173. Longitude 24^s W.

Elements of Minor Planet (66).

(*Communicated by Prof. Bond.*)

Mr. Hall finds the following elements for the new asteroid (66), which has received the name of *Maia*, confirmed by Hon. Josiah Quincy, the venerable ex-President of Harvard College:

Epoch, 1861, May 16·35748, Washington M.T.

M	139 27 11·9	
ϖ	43 54 5·7	Mean Equinox, 1861·0.
Ω	8 11 41·7	
i	3 4 8·8	
φ	8 52 19·5	
Log a	0·423879	
μ	820″·71	

By reason of the date of the discovery by Mr. Pogson of the Minor Planet *Asia* the numbers of the last four Minor Planets are:—

(67) *Asia*, Mr. Pogson.
(68) *Leto*, Dr. Luther.
(69) .. M. Schiaparelli.
(70) *Panopea*, M. Goldschmidt.

Places of Comet I. 1861. By N. M. R. Edmondson, Assistant, Armagh Observatory.

G.M.T.	R.A.	Par. in R.A.	N.P.D.	Par. in N.P.D.
	h m s	s	° ′ ″	″
May 10·4443	8 56 21·22	$+\varpi\times$0·0390	67 28 33·56	$-\varpi\times$0·6656
12·4252	8 44 47·49	0·0369	73 59 47·97	0·7155
14·4563	8 34 39·98	0·0391	79 55 40·40	0·7853

Stars.	Comparisons.	Assumed Places.
77 Cancri	5	Armagh Catalogue.
63 ,,	5	,,
36 ,,	4	,,

Elements and Ephemeris of Comet I. 1861. By Dr. C. F. Pape.

Elliptic Elements from April 10, May 1 and 2, and May 18.

T = June 3·22854 Mean Berlin Time.

ϖ	= 243 3 15·2	Mean Equinox 1861·0
Ω	= 29 51 9·8	
i	= 79 55 3·7	
log e	= 9·997335	
log q	= 9·964536	
log a	= 2·177951	

Period = 1848·9 years.

Ephemeris for 0^h Mean Berlin Time, available for Mean Equinox.

1861.	R.A.	Decl.	Log r (Sun).	Log Δ (Earth).	Bright-ness.	Rises before Sun.
	° ′	° ′				h
July 21	104 23·5	34 4·8	0·09320	0·16443	0·25	3·7
23	104 1·5	34 30·8				
25	103 39·3	34 57·3	0·10861	0·17246	0·22	4·1
27	103 16·6	35 24·3				
29	102 53·4	35 52·0	0·12390	0·17922	0·20	4·4
31	102 29·5	36 20·3				
Aug. 2	102 4·8	36 49·2	0·13901	0·18479	0·18	4·7
4	101 38·9	37 18·6				
6	101 11·8	−37 48·6	0·15377	0·18927	0·17	5·0

The brightness is assumed = 1·0 on April 10, when the Comet was about 6 mag. The rising of the Comet is calculated for the latitude of the Cape Observatory.

Altona, June 4, 1861.

Observations of Comet I. 1861, *made with the Olcott Meridian Circle, at the Dudley Observatory.* Observed by G. W. Hough.

(*Communicated by Professor O. M. Mitchel through the Astronomer Royal.*)

Date.	Mean Time of Obs.	App. R.A.	App. Decl.
	h m s	h m s	° ′ ″
April 11	15 38 38·57	17 0 45·51	+60 21 25·37
17	14 19 58·29	16 4 12·61	65 7 16·73
19	13 39 22·98	15 32 42·77	66 34 3·16
24	11 22 40·44	13 35 20·54	67 45 20·68
25	10 50 16·98	13 6 48·31	67 10 47·57
26	10 17 42·63	12 38 5·17	+66 13 3·54

The Declinations are corrected for refraction, but not parallax.

The Right Ascensions are the mean of fifteen wires, with the exception of April 17th, when only two were observed.

April 25th, Strong moonlight; Comet very difficult to observe.

Prof. Bond, in a letter dated Observatory of Harvard College, 4th June, 1861, addressed to Mr. Carrington, writes as follows:—

I notice, in the *Monthly Notices* for April, that Mr. Thatcher

communicates an observation of the Comet I., 1861, to the Astronomer Royal, as follows:—

1861, April 10, $11^h\,32^m\,42^s$.

R.A. $17^h\,7^m\,42^s{\cdot}76$ Decl. $+59°\,30'\,8''$.

The observation intended is evidently that made at Cambridge on the 10th, appropriated, as it is printed in the *Notices*, *without* an acknowledgment, and *with* two important errors. The time is Cambridge, not New York time; and the declination should read

$+59°\,28'\,12''\,8$.

The right ascension is more precisely

$17^h\,7^m\,42^s{\cdot}60$,

as reported to you in my letter of the 25th April.

The correction is of some consequence, as the position is one of the earliest obtained of the Comet.

Capt. Shea continues with regularity, and sends to the Society, the Observations of Solar Spots which he has been engaged on for several years past.

Accounts have been received of the large Comet which has recently appeared. Mr. Burder, in a letter dated Clifton, June 30, 1861, 4 P.M., addressed to the Secretary of the Society, writes:—

"I saw a Comet at $2^h\,40^m$ A.M. to-day,* and lost sight of it (through the approach of daylight) at $3^h\,20^m$ A.M. It was as bright as *Capella*. It had no tail that I could see, but it had a bright nucleus surrounded by a nebulous haze.

"Its azimuth at $3^h\,10^m$ A.M. was about 39° east of north, and its altitude about 10°, both *very rough* observations, as I had not time to apply instruments; or rather was afraid to run the risk of losing the object in the increasing daylight while preparing them. I therefore made the best of neighbouring buildings, the position of which I measured afterwards."

Mr. Stothard, in a letter dated Dublin, July 1st, 1861, writes:—

"On last evening (June 30th), about 10 o'clock P.M., Dublin time, as I was closing my instrument, after an observation of *Jupiter*, I was very much surprised at seeing a remarkable-looking nebulosity in the full glare of the twilight, in the north-west part of the heavens, which twilight was then so great as to render invisible all stars in those regions nearly as far as the zenith. I soon perceived in the object a distinct and

* Viz. on the *morning* of June 30.—Ed.

planetary-looking nucleus, which was well seen in an opera-glass, and shone out like the disk of a planet seen with a low power with a dense halo round it.

"This halo I found to be of a semi-lunar form, the convexity being in the direction of the Sun. I saw this well both in a large opera-glass and in my $2\frac{1}{2}$-inch achromatic, with the lowest power I have, an erecting eye-piece of 22.

"As the twilight faded, the tail came out; but, although I watched until midnight, the night was not dark enough to show it well.

"I could not help thinking that, had it been a dark season of the year, and the Comet been higher in the sky, it would have been one of the most remarkable seen for many years, larger, and I should say (under the same circumstances) more brilliant, than that of 1858 (Donati's).

"The Comet at midnight was almost due north, and must have been in or near the constellation *Auriga;* but I could not see the stars in that neighbourhood with the unaided eye. I did see one with the $2\frac{1}{2}$-inch refractor, a little lower, and following. Its altitude was low at 12^h.

"The suddenness of its apparition, together with its size and brilliancy, is remarkable.

"I have no doubt, from these two latter qualities, size and brilliancy, that it must have been visible for some time in these latitudes; but as yet we have heard nothing about it here."

Mr. Tidmarsh, in a letter dated Downside College, Bath, July 1st, 1861, calls attention to a splendid Comet, "which has been visible here during the night in the constellation of *Auriga*, situated at present about as far from *β Aurigæ* as that star is distant from *Capella*, and about the same north declination as *Capella*.

"The nucleus is very large and bright, and was distinctly visible to the naked eye as a Comet before half-past nine o'clock, P.M.

"It passed its lower transit at about ten minutes past midnight, and the huge tail then extended at least sixty or seventy degrees across the heavens. It could be distinctly traced across *Polaris*, and considerably beyond, nearly in the direction of *Vega*."

The following observation, made with the transit-circle at the Royal Observatory, Greenwich, by W. J. Carpenter, has also been received:—

	Greenwich M.T.	App. R.A.	App. N.P.D.
1861, June	$30^d\ 12^h\ 5^m\ 53^s{\cdot}9$	$6^h\ 42^m\ 1^s{\cdot}48$	$43^\circ\ 0'\ 8''{\cdot}2$.

The N.P.D. is corrected for refraction.

Daily motion in R.A..... $+48^m$ } Approximate.
,, ,, N.P.D..... -8° }

ERRATA.

Page 211, line 26 from top, *for* third, *read* first.

— 214, — 29 — *for* a point on the other, *read* one or the other.

— — — 12 from bottom, *for* desk, and bottom line *for* disk, *read* dish.

— 215, lines 16, 17 from top, *for* pen A *and* pen B, *read* bar A *and* bar B.

— — line 19 from top, *for* instantaneously, *read* simultaneously.

CONTENTS.

	Page
Fellows elected	221
On the Secular Acceleration of the Moon's Mean Motion, by Professor Donkin	ib.
On the Lunar Theory, by M. de Pontécoulant	229
Observations of the Variable Star *η Argus*, by Mr. Abbott	230
On the Probable Identification of Anthelm's Variable of 1670 (*Nova Vulpeculæ*), and on some other Variable Stars, by Mr. Hind ...	231
On the Nomenclature of the Minor Planets, by Mr. Hind	233
Note on the Disposition of the Penumbra of a Solar Spot, by Mr. Best	235
On the Ring of *Saturn*, by Mr. Lassell	236
On the Ring of *Saturn* and on *Jupiter's* Satellites, by Capt. Jacob ...	237
Note on an Appearance observed on *Jupiter* by Mr. Birt, March 22, 1861, by Mr. Baxendell	238
Results of Meridional Observations of Small Planets; Occultation of a Star by the Moon; and Phenomena of *Jupiter's* Satellites; observed at the Royal Observatory, Greenwich, during the month of May, 1861	ib.
Occultation of *Mars* by the Moon, observed at the Dudley Observatory, 1861, May 12, by O. M. Mitchel, jun.	239
Occultation observed at Highbury, by Mr. Burr	ib.
Elements of Minor Planet (66), communicated by Professor Bond ...	240
Places of Comet I. 1861, by Mr. Edmondson	ib.
Elements and Ephemeris of Comet I. 1861, by Dr. C. F. Pape ...	ib.
Observations of Comet I. 1861, made with the Olcott Meridian Circle, at the Dudley Observatory, by Mr. Hough, communicated by Professor Mitchel, through the Astronomer Royal	241
On the same Comet, by Prof. Bond	ib.
On the Solar Spots, by Capt. Shea	242
Observations of the large Comet, by Messrs. Burder, Stothard, Tidmarsh, and Carpenter	ib.

Printed by STRANGEWAYS and WALDEN, Castle St. Leicester Sq., and Published at the Apartments of the Society, July 16, 1861.